



Overview of ELF and VLF waves observed in deep equatorial plasma density depletions during intense magnetic storms

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One of the most spectacular ionospheric phenomena at low latitudes during the early phase of strong magnetic storms is the occurrence in the pre-midnight LT sector of dramatic, large-scale plasma depletions in the F-region ionosphere in which the plasma density typically may be reduced by 2 to 3 orders of magnitude compared to that of the undisturbed background ionosphere. Wave measurements carried out by the DEMETER satellite in such deep plasma depletions during tropospheric-thunderstorm periods show the occurrence of broadband and localized lower-hybrid turbulence triggered by lightning-induced whistlers. High-sample-rate waveforms reveal that the lower-hybrid turbulence can evolve into solitary structures similar to lower-hybrid envelope solitons commonly observed along high latitude magnetic field lines associated with the discrete aurora. Simultaneous with this lower-hybrid turbulence, ion tail heating is also observed. Such processes bear a striking similarity with those observed at high latitudes, but were totally unexpected along equatorial field lines. Besides these emissions and the strong, broadband ELF electrostatic turbulence associated with large plasma irregularities developing on the density gradients at the edges of the depletions, another salient and very intriguing feature is the observation, exactly coincident with the extent of the depletions, of an intense, narrow-band electromagnetic ELF emission at frequencies slightly below the proton gyrofrequency. We present some representative events and discuss the observations.